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B.

Missile Defense Agency Target Requirements and Certification Process

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MISSILE DEFENSE AGENCY TARGET REQUIREMENTS AND CERTIFICATION PROCESS

Mr. Neal Ortego*

MDA Target Requirements and Certification

Abstract

Over the last decade, considerable emphasis has been placed on tighter control over the quality and fidelity of test targets being used by Major Defense Acquisition Programs (MDAPs). To this end, the Target Verification, Validation and Accreditation (VV&A) process was developed. The VV&A process was designed to ensure that any target under development could trace its physical and signature characteristics and kinematic behavior to detailed, intelligence community-blessed threat specifications. As a target was developed, specification tracking focused on how well the target matched the threat definitions. This often affected the program's ability to conduct an effective test program, especially when the very real constraints of safety, range and treaty limitations were taken into consideration as a program approached its actual test period. The Ballistic Missile Defense Organization (BMDO), as an organization charged with orchestrating various service-executed MDAPs, followed this strict measure of adherence to threat representation in its management of the test targets program.

With the creation of the Missile Defense Agency (MDA), and its focus on developmental testing (DT), layered defense and spiral development, there is no longer a need to adhere to threat-specific processes in the test and evaluation (T&E) program. What has emerged is an opportunity to focus Ballistic Missile Defense (BMD) testing and test target requirements development, traceability, and ultimate certification on the fundamental T&E goal of performing valid and suitable tests, which are optimized to fully characterize the performance capability of the system, element, or component under test. Thus, early in the "capabilities-based acquisition process," the targets may or may not be as stressing to the system as observed threats. Later in the design process, the testing should be using targets that may be more stressing than any observed threat—perhaps even approaching target physical limitations. In this "capabilities-based" environment, the charge to the MDA Test and Assessment Deputate is to be more efficient and more responsive to Program

needs. T&E management must insure that test programs are well planned, well designed, and that the proper resources, including targets, are available for test execution.

To take advantage of this opportunity and ensure better test effectiveness, the MDA has implemented a more robust Requirements & Certification (R&C) Process that is aimed specifically at providing the various MDA/Ballistic Missile Defense System (BMDS) Project Managers with the forum, format and timely support necessary to better optimize their test programs under the "capability-based acquisition" strategy. The improved Target R&C Process focuses target development on test objectives from the start. All required target characteristics are derived from test objectives; test objectives are designed to capture specific measurable data required to increase the confidence with which performance capability can be described. Throughout the entire process of target development, delivery and characterization, required target characteristics always track back to the program's test objectives. The goal is that all tests not just appear to turn out well but that their results are meaningful in the context of performance capability characterization. This new MDA Target R&C Process provides increased traceability, identifies program target needs sooner, and documents the impacts of real world constraints earlier as the target development is baselined and used for target acquisition control. As-built targets are characterized and compared to current test objectives. Suitability of the actual target intended for use in a specific test can be confidently certified. In the final analyses, this R&C Process promises to increase MDA's ability to predict BMD capability into an actual battle region with greater assurance.

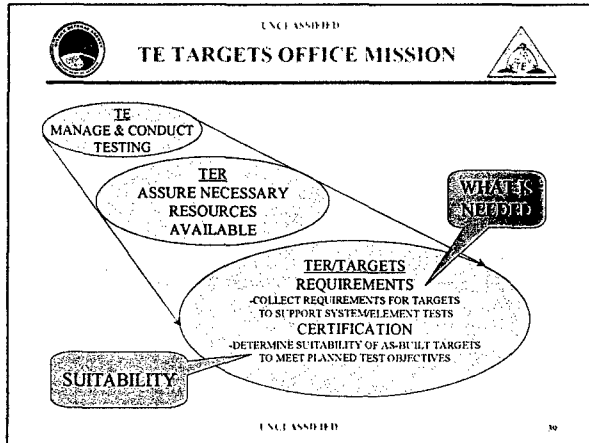
Overview

This paper addresses the target requirements and certification process past and present and why change is appropriate now. Several update objectives are described. The old VV&A process (w/ added Certification) is described – followed by the new integrated process. The performance of the new process against each objective is reviewed comparing old and new. Also discussed is the approach underway to implement the updated process.

Within the MDA, The Deputy for Test and Assessment (MDA/TE) is charged with managing and conducting T&E for the BMDS and its elements. Within the Deputate, the Director of Test Resources (MDA/TER) is responsible for assuring that all necessary resources

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are available for the conduct of BMDS and element T&E. Finally, within the Resource Directorate, the Targets Requirements and Certification Office (MDA/TERF) is responsible for managing and executing the Target Requirements and Certification Process for all targets used for BMD testing. From a target perspective, the process begins with determining what is required to support a test and concludes with the determination that that which is provided is suitable to meet test objectives.



Previous Situation

BMDO, previously limited to operating as an organization, focused on providing some oversight to service execution of BMDS MDAPs. Other organizations within the Office of the Secretary of Defense (OSD) directed and controlled the target VV&A process. Fundamentally, all targets were required to be threat-based. All threats were required to be Defense Intelligence Agency-approved. Tracking the existence of test objectives was not a high priority (if even possible).

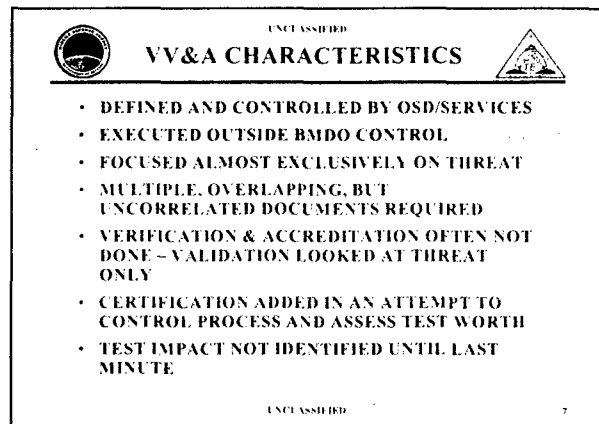
Old VV&A

The old VV&A process asked very threat-focused questions. Certification was later added on to this process to address the Director's concern that, even with the VV&A process, threats and targets were not being adequately controlled or uniformly applied.

The VV&A process itself was essentially Operational Test (OT) driven and focused almost exclusively on "threat" realism (not on valid testing). Often threat descriptions continued to evolve, resulting in the never-ending task of having the target design chase the threat. Meanwhile, multiple documents were generated by various participants, often containing similar information from different sources and each required endless updating right up until test execution.

Within VV&A, Verification (Step 1) was often not done rigorously, since existing threat definitions were seldom detailed enough to directly support good test engineering. Where detailed threat definition was available, it required constant revisiting and revision due to our understanding of the threat evolving over time.

Validation (Step 2) looked only at whether or not the as-built target looked like the latest threat definition. Validation did not concern itself with what was expected of the target when it was first ordered or why it might not match either current test requirements or the threat as currently understood.



Accreditation (Step 3) focused on the MDAPs view of the target and how well it suited the planned test. It did not focus on whether the target was good, bad, or provided the stimuli needed for system characterization.

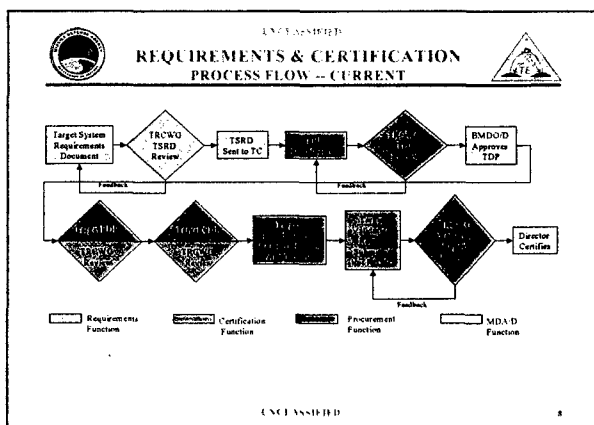
On October 12, 2000 the BMDO Director signed a Directive that stipulated that all BMD Testing would be conducted with BMDO certified targets. This Directive also established the Target Requirements and Certification Working Group (TRCWG) as the body that would insure that target development was traceable to test planning and that all targets were suitable to meet test objectives.

Certification (the added step) was a BMDO initiative designed to focus management's attention on the quality and adequacy of targets being developed for and used by the various MDAP test programs. The challenge was to insert a new step into a well-established process, and then accommodate a myriad of threat-based legacy target systems that were already planned, paid for, and under development. This step was successful in identifying problems in target design, but occurred so late in the target development cycle

that there was little, if any, time or funding to initiate corrective action.

Previous Process Flow

All recent attempts to rationalize the VV&A (& C - Certification) process flow have been forced to exist within this basic, threat-driven framework. Under the BMDO Directive, the process flow used the TRCWG as the primary body for attempting to impose order on the process. The initial target requirements (usually designed to emulate some "known" threat or subset thereof) were developed by the various element program offices and delivered to BMDO in the form of a Target System Requirements Document (TSRD). Most of these TSRDs read very much like a hardware development specification. Their main intent was to specify the characteristics of a target intended to emulate some particular threat or class of threat. Following TRCWG review of these TSRDs, the TRCWG would issue a Target Execution Order (TEO) and submit both the TSRD and TEO to the Targets and Countermeasures Program Manager (then BMDO/TC) for execution.



The Target Program Office then developed a Target Support Plan (TSP) and submitted it to the TRCWG for review to determine if the target build plan matched or came close to the target required. At the same time, the TSRD was still being updated regularly by the element program offices to reflect their latest program changes. The intelligence community continued to update its understanding of the "real" threat even as target development was underway. Most recently, BMDO/TC began the process of developing a Target Program Baseline (TPB) and a Target Development Plan (TDP) and placing both under configuration control after a TRCWG review to insure that they incorporated all the TSRD requirements.

The TRCWG was then to track the target development through SRR, PDR, CDR, etc., verifying that any

changes from the baseline TSRD were agreed to by the TRCWG members as still meeting program requirements. Any change deemed a major deviation from the TSRD or approved baseline would need to be staffed back through the BMDO Configuration Control Board for approval. After the target was built, the final Target Validation Report (developed for and under control of the OSD or the Service Operational Test Agency) was to be written. BMDO/TER would then generate another separate report for certification. This report addressed how the completed target met the TSRD requirements (partial or total threat emulation) and how the actual target and deviations (if any) from the original requirements would effect testing. The BMDO Director then approved the Certification Report.

Current Situation

The creation of the MDA and the restructuring and realignment of the various Service missile defense programs created an Agency with the authority and responsibility to execute an integrated BMDS program and focus on Developmental Testing. Individual program elements are now inside (a part of) MDA. The Director, MDA (MDA/D) has basic milestone authority up to transition of a capability to one or more of the Services. OSD and the Services no longer control the "VV&A" and testing process.

Previously, threat-based, requirements-driven acquisition provided specific, point design threat against which a defensive system was designed. Targets attempted to match the point design threat as closely as possible. Now, under capability-based acquisition, test objectives are designed to explore the full range of the defensive system's battle space capability and are not limited to demonstrating performance only against specific point threats.

Full performance capability characterization dictates targets be developed to support rational test objectives without regard for how exactly they represent a "real", validated threat. Ultimately any assessment of the system capability to address "actual threats" is done at the system engineering level when the system's "Battle Space" capability is determined.

This performance characterization presented the opportunity to address the shortfalls in the old VV&A/Certification process. MDA could now focus test resources on the conduct of the right tests using the right targets in order to fully characterize BMDS performance capability. The process could be made both more efficient and the products of the process could now have more direct value to the development process.

Objectives

Three specific areas presented themselves as potential opportunities for improvement:

- Focus on Test Objectives
- Increase Process Efficiency
- Become More Responsive to Programs

Test Objective Focus

In an attempt to optimize target utility in an era of performance capability characterization, the driving concern must be that targets are suitable to support the test objectives rather than simply "look like the threat." While it is natural that any target designed to provide stimulus to a defensive weapon system will resemble, sometimes even closely, an actual observed potential adversary threat, the focus of the target development process should be on assuring that the target best supports the testing being performed. An objective of the updated process is, therefore, that the required target-critical characteristics be matched to the test objectives for which they are being provided.

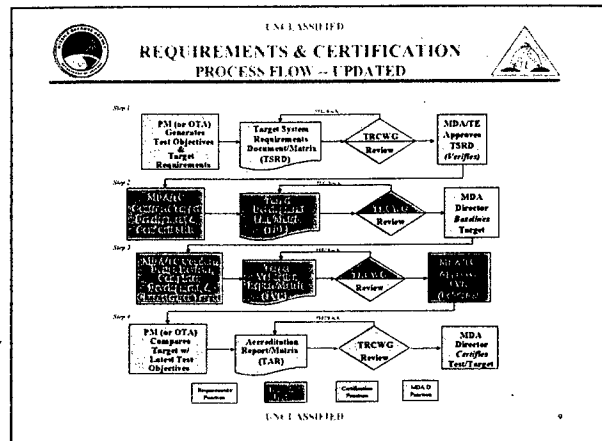
Process Efficiency

By its very nature, the process of developing test objective-focused target requirements, monitoring the target development designed to satisfy these requirements, reporting on the extent to which these requirements have been satisfied and how well they continue to meet test needs, all require review, analyses and presentation of the same data. The objective of the updated process is, therefore, to streamline and standardize the content and format of the various process documents.

Responsiveness

A major shortfall of the old process was manifested just before each scheduled test flight whenever a potential problem with target design was noted. By the time the issue was understood, there remained essentially no time to effect improvements. A corollary to this manifestation included having incomplete documentation of the necessary test program changes made along the way. There are often target trade-offs to be made that are caused by the practicality of real-world testing. For example, no matter the motivation, it is essentially impossible to actually test fly a "real threat." Range, safety, environmental factors, data needs and treaty constraints all conspire to force the target article and test program away from what good engineering practices might otherwise suggest. An objective of the updated process is, therefore, to document both the necessary changes as they are made and to highlight any disconnects early

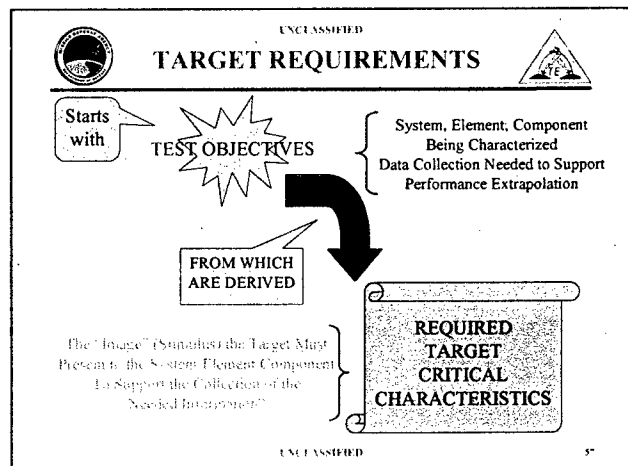
enough in the process so constructive responses can be determined and implemented.



Updated Process Flow

The updated process can be thought of as having 4 steps:

- Step 1 – Requirements Development [MDA/TE lead]
- Step 2 – Target Development Baseline [MDA/TC lead]
- Step 3 – Target Build and Characterization [MDA/TC lead]
- Step 4 – Test/Target Accreditation/Certification [MDA/TE lead]



Step 1 – Target Requirements Development

Entry into the Requirements and Certification (R&C) process begins with determining the requirements for the target. From a system or element's approved master test plan, individual tests are designed to address and characterize the performance capability of

the system, sub-system or components. In each of these tests, specific test objectives are determined and, in order to satisfy these test objectives, targets with certain characteristics are required. These requirements are documented in TSRDs prepared by MDA Offices and Project Managers. The TRCWG reviews the TSRDs to assure that the required target critical characteristics support the listed test objectives, and MDA/TE approves the TSRDs for target development. No further updating is expected during the test program barring a wholesale program revision. MDA/TE has the lead in the entry step in the updated R&C Process.

Step 2 – Target Development Baseline

The next step in the R&C Process takes the approved target requirements from step one and begins target development. This second step, under the lead of MDA/TC, is designed to determine an acceptable target development strategy to meet the program test needs (cost, performance, and schedule). Real-world issues (e.g., safety, range, current target design availability, schedule, cost and treaty constraints, etc.) are laid against the program test requirements and a TPB and a TDP are developed. These documents are reviewed by the TRCWG to assure continued compatibility between planned test objectives and planned target characteristics. These characteristics are put under configuration control. At this point, if real world constraints have dictated a change to executable test objectives, this action is reviewed, approved by competent authority and documented along with an explanation/ recommendation for their adoption.

Step 3 – Target Build & Characterization

The next step in the R&C Process takes the baseline target development plan from step two and continues target development. This third step, also under the lead of MDA/TC, is intended to design, develop, and acquire a suitable target to meet the program test needs. At each review the TRCWG continues to monitor target development against target requirements. Throughout the target development process these baseline target expectations are used to measure progress. At the close of this step the actual, as-built target is characterized and once again compared to the required target critical characteristics. Full target characterization is captured for use by the program in its modeling and simulation. Following target characterization, MDA/TC writes a Target Validation Report (TVR), documenting the actual or predicted characteristics of the as-built target as compared to the required characteristics documented in the TDP along with an explanation for the differences, if any. The TRCWG reviews the TVR to assure continued suitability.

Step 4 – Test/Target Accreditation and Certification

The final step in the R&C Process takes all of the information collected in the previous three steps and addresses the suitability of the as-built target. Although this fourth step is under the lead of MDA/TE, the system/element project lead or the Operational Testing Agent (OTA) undertakes the final comparative analyses of the as-built target against the final test objectives planned for the upcoming test. MDA/TE drafts and the system/element project lead completes the Target Accreditation Report (TAR). The TRCWG reviews and prepares a Certification Memorandum for approval by the Director, MDA. The Certification package details the extent and limitations of the suitability of the target to meet the intended test objectives. Where necessary, any impacts and/or workarounds are also documented.

Documentation

At each step in the R&C Process, each document is basically a matrix reporting and tracking test objectives, target requirements, target design parameters, any subsequent changes in any of these baselined "specs", the rationale behind the changes, and any resulting impacts to the test program. The following paragraphs describe the required documents. New documents, or updated documents, are noted with the symbol "❖."

Step 1 -- Target Requirements Development (Verification)

Target requirements are defined in the Target System Requirements Document (TSRD). As an extension of the MDA/TE-approved test plans, this first R&C step, under the lead of MDA/TE, is designed to capture and approve three basic test data elements:

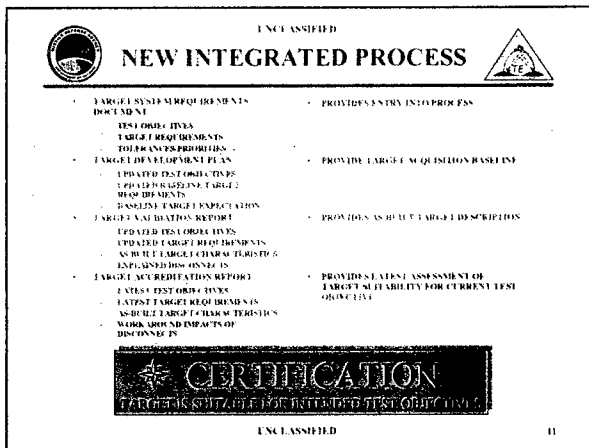
- ❖ Test objectives requiring specific target characteristics
- ❖ Required target critical characteristics (TCC) (with tolerances)
- ❖ Criticality ranking of required TCC (to assist in later potential trade-off analyses)

Step 2 – Target Acquisition Baseline:

The Target Program Baseline (TPB) and the Target Development Plan (TDP) are reviewed by the TRCWG, placed under configuration control, and used as the baseline for both target development and program test planning. The TDP adds (❖) to the Step 1 TSRD and provides:

- Test objectives (❖ updated as required)

- Required TCC (with tolerances) (❖ updated as required)
- Criticality ranking of TCC (❖ updated as required)
- ❖ Notes highlighting and explaining Test Objective/Requirements/Criticality changes
- ❖ Expected target characteristics (planned to result from target development/acquisition)
- ❖ Notes highlighting and explaining expected target characteristic differences (if any are anticipated) from required target characteristics



Step 3 – Target Characterization/Validation:

The comparative target validation analysis is documented in a further update to the previous matrix information. This Target Validation Report (TVR) is then approved by the MDA/TC (and in the case of OT, forwarded to DOT&E as part of their validation cycle). In any case, the TVR is returned to the program office for use in step four to follow. The Target Validation Report (TVR) adds (❖) to the Step 2. TDP and provides:

- Test objectives (❖ updated as required)
- Required TCC (with tolerances) (❖ updated as required)
- Criticality ranking of TCC (❖ updated as required)
- Notes highlighting and explaining Test Objective/Requirements/Criticality changes (❖ adding further notes as required)
- Expected target characteristics (intended to result from target development)

- Notes highlighting and explaining expected target characteristic differences (if any) from required target characteristics
- ❖ Actual or predicted, as-built target characteristics
- ❖ Notes highlighting and explaining actual or predicted, as-built target characteristic differences (if any) against expected target characteristics

Step 4 Target Accreditation and Certification:

The comparative target accreditation analysis is documented in a last update of the previous matrix information. This Target Accreditation Report (TAR), drafted by MDA/TER and completed by the PM/OTA, is reviewed by the TRCWG and is forwarded under a certification cover memorandum by the MDA/TE to the Director, MDA for final approval (and in the case of OT, also forwarded to DOT&E). This approval constitutes final certification of this particular test objective and target combination. The TAR, drafted by MDA/TE from the previous matrix information and completed by the PM/OTA, adds (❖) to the Step 3 TVR and provides:

- Test objectives (❖ updated as required to reflect current test plan)
- Required TCC (with tolerances) (❖ updated as required)
- Criticality ranking of TCC (❖ updated as required)
- Notes highlighting and explaining Test Objective/Requirements/Criticality changes (❖ adding further notes as required)
- Expected target characteristics (intended to result from target development)
- Notes highlighting and explaining expected target characteristic differences (if any) from expected target characteristics
- Actual or predicted, as-built target characteristics
- Notes highlighting and explaining actual target characteristic differences (if any) from required target characteristics
- ❖ Notes addressing the programmatic workarounds and/or impacts of any differences
- ❖ Recommendation as to the extent and limitations (if any) of target suitability to meet as-intended test objectives.

Review of Objectives

The remainder of this paper will review the three objectives established for the R&C Process improvement exercise. Does the updated process address the objectives for which it was undertaken?

Objective One – Focus on Test Objectives

We asked first that the target process focus more directly on test objectives rather than spend its energies trying to chase that day's understanding of a given threat. Previously, while pursuing an elusive and ever evolving threat definition, suitability of a target was often overcome by the need to emulate the current consensus estimate of the threat. By the time the final certification exercise reviewed the test in question, the test and target were no longer an optimum match for each other. However, by the time this became evident, little time or resources remained with which to address the issue; and, with the need to chase the threat still paramount, the ability to optimize the test program was severely compromised.

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OBJECTIVE ONE FOCUS ON TEST OBJECTIVES	
• OLD	• NEW
<ul style="list-style-type: none"> - THREAT-BASED - TEST OBJECTIVES SHELVED - DID NOT ADEQUATELY ADDRESS TEST SUITABILITY - DISCONNECTS SURFACED LATE - ADDITIONAL CERTIFICATION ANALYSIS REQUIRED 	<ul style="list-style-type: none"> - TEST OBJECTIVE-BASED - DIRECTLY LINKED TO SYSTEM CAPABILITY CHARACTERIZATION - THREAT (IF REQUIRED) IS NOT LOST - DISCONNECTS IDENTIFIED EARLY AND REVISITED - CERTIFICATION OF SUITABILITY A NATURAL OUTCOME
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Now, the new R&C Process has a test objective focus from the very beginning. The very definition of the required target is driven solely by the objectives for which the test is being conducted. The only requirement on the target is that it provides the proper stimulus so that the tested system's performance capability characterization can be ascertained. Traceability to threat-related battle space is still very apparent. The target, however, can be optimized for test data collection rather than dubious threat emulation. Disconnects between target characteristics and test objective needs can be identified early and certification of target/test suitability follows directly.

Objective Two – Increase Efficiency



We started with a process that required at least five different analyses and reports of findings. Each analysis started anew and each report presented its findings (or requirements) with a dissimilar purpose and format. When the target requirements and VV&A processes were completed, a whole new certification exercise still needed to be conducted. Each step along the way required duplicating much of the work in the previous steps and then presented its results in a manner not readily comparable to the results from other steps.

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OBJECTIVE TWO INCREASE EFFICIENCY	
• OLD	• NEW
<ul style="list-style-type: none"> - EACH DOCUMENT SEPARATELY DEFINED, FORMATTED & GENERATED - ADDITIONAL UPDATED INFORMATION REQUIRED TO CERTIFY 	<ul style="list-style-type: none"> - ALL DOCUMENTS FORMATTED ALIKE - EACH DOCUMENT MATRIX BUILDS ON THE PREVIOUS - CERTIFICATION FOLLOWS FROM COMPILE OF DOCUMENTATION
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Now, all steps in the process have a common goal, format and end product: a target that is suitable to meet intended test objectives. Each document, built in a matrix fashion, builds on the contents of the previous step. The documentation at each step is focused on tracking the test objective, required target critical characteristics, and assuring the target, when delivered, matches these requirements. Status of suitability is known from the outset and throughout the development process. Certification naturally follows with a minimum of late-breaking issues.

Objective Three – Be More Responsive

Previously, by the time a test came around, traceability to the original test objectives or target requirements was difficult to reconstruct. What the target was intended to support and the impact of any shortfalls was difficult to determine. This was especially disruptive when test and target disconnects surfaced very late in the testing schedule. It could seldom be known early on just what certification could be expected for a given test-target combination; and, perhaps worse, chasing an after-the-fact understanding of suitability was clearly not getting optimum results from the testing program.

<div style="display: flex; justify-content: space-between; align-items: center;">  <div style="text-align: center;"> <small>UNCLASSIFIED</small> OBJECTIVE THREE BE MORE RESPONSIVE </div>  </div>	
<ul style="list-style-type: none"> • OLD - ORIGINAL TEST OBJECTIVES & TARGET REQUIREMENTS LOST - BASELINE TARGET DEFINITION HARD TO IDENTIFY - DISCONNECTS IDENTIFIED TOO LATE TO BE ADDRESSED - PROGRAM EXPECTATION OF CERTIFICATION UNCERTAIN 	<ul style="list-style-type: none"> • NEW - ALL TEST OBJECTIVES & TARGET REQUIREMENTS DOCUMENTED AND TRACKED - BASELINE TARGET DEFINITION EXPLICIT - DISCONNECTS IDENTIFIED EARLY AND REVISITED REPEATEDLY - CERTIFICATION CRITERIA EXPLICIT
<small>UNCLASSIFIED</small>	

Now, all test objectives and required target critical characteristics are documented and tracked right from the start of the process. Test objectives and target requirements are baselined early and, as development proceeds, shortfalls can be identified and addressed early. The sole criterion for certification is the suitability of the target to meet test objectives. This is explicitly available to all participants early in the process. Shortfalls are more easily highlighted and time is available to affect a more optimum test-target match. The process is therefore more responsive to the needs of a dynamic test program.

Summary

The development of the BMDS and its elements has transitioned from being requirements-driven to being capability-driven. While overall system and element battle space must remain traceable to validated threats, targets are not each individually required to emulate specific validated threats. Rather, since testing is designed to characterize the BMD system's/ element's capabilities, targets are required to support obtaining credible results under the test objectives for which the targets are being provided. Therefore, the focus for target R&C has been refocused on providing test objective-relevant test articles. The sole criterion for certification is that of suitability; that the target adequately and appropriately satisfies the intended test objectives. Certification itself details the extent to which intended test objectives are credibly supported by the target to be used.

The updated process is intended to focus the target R&C efforts directly on test objective support. It is formatted to streamline documentation and to lessen the duplication of effort required of multiple, unconnected documents by forcing a commonality of content and format throughout the process. And, finally, it is fashioned to provide insight and support to all facets of the BMD test program early enough to be of use to the participants. The goal of a more optimum test-target combination is rapidly becoming a reality.